

Engineered Ceramic-Organic Interfaces: Properties and Applications

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Nanoporous materials offer extremely high surface area, and therefore potentially superior performance for applications such as catalysis. Using the procedure outlined in Figure 1, powders containing mixed titania-vanadia nanotubes (Figure 2) have been produced. The synthesis route is energy efficient and environmentally benign, using simple aqueous solutions and temperatures below 100°C. Furthermore, early results show that this nanoporous material is 25% more effective as a catalyst for oxidation of lactic acid than material made by the identical route, but lacking nanoporosity.

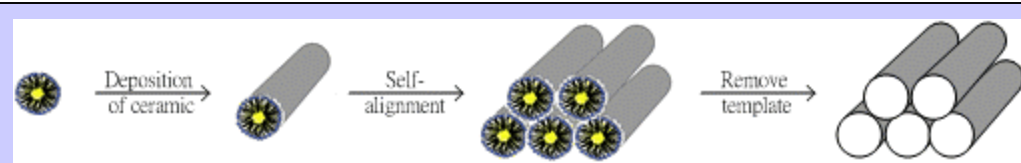


Figure 1. Schematic illustration of the formation of ceramic nanotubes on micelles of organic surfactants. Use of the proper hydrophilic projecting functional group on the micelle (far left) promotes deposition of an oxide coating from the surrounding aqueous solution (middle left). The structure may assemble as aligned tubules (middle right). The resulting material can then be rinsed and dried to yield clusters of ceramic nanotubes (far right).

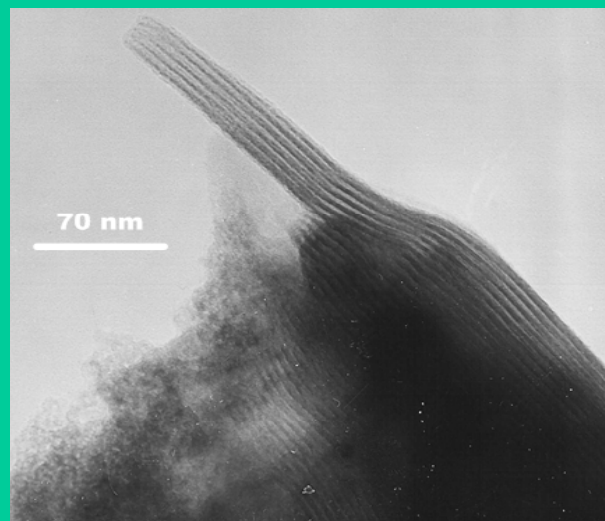


Figure 2. TEM image of nanoporous mixed oxide powder (45cat.% Ti, 55 cat.% V) containing oxide nanotubes. Electron and x-ray diffraction results indicate that the crystal structure is anatase, and that the average pore size of the material is 4 nm.

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Education:

In its first two years of funding, the project has supported the research of four graduate students (Mr. Jing-Jong Shyue, Mr. Matthew Croyle, Ms. Lijun Zou, and Ms. Yin Tang) and one undergraduate (Maria Salamon). Ms. Salamon will apply to graduate school in Materials Science at Case in 2004. Mr. Shyue finished his M.S. in 2003 and is continuing on the project for his Ph.D. Ms. Zou received her M.S. in 2003 and is pursuing doctoral work.

Outreach:

Dr. Paul Kayima of the Sherwin-Williams Co. in Cleveland is co-PI on this GOALI project, and Matt Croyle is a full-time staff engineer there.

Mr. Shyue spent four weeks as a guest researcher at the laboratory of Prof. Kunihoto Koumoto and Dr. Yoshitake Masuda at Nagoya University in Japan on work related to ceramic-organic interfaces.

The PI was lead organizer of the international symposium on *Nanostructured Materials and Nanotechnology* at the 105th Annual Meeting of the American Ceramic Society in April 2003.